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has drawn freely from Williston, Broili and others in this part of the work.

The description of two new cockroaches by Dr. Sellards is of special interest, as these are the first insects to be described from the Permian of Texas.

In the discussion of the Permian fishes of North America, Dr. Hussakof points out that Cope, in a series of papers between 1875 and 1894, created several species without justification because of too fragmentary material or the failure to allow for individual variation. Through a restudy of Cope's types in the American Museum, the Gurley Collection at the University of Chicago, and with the addition of new material, Dr. Hussakof has added four new genera, which makes 14 in all. Curiously enough, however, because of subtractions and additions, the number of species is 22, the same as was given by Cope. In an appended table of comparisons some interesting things are brought out; it is pointed out that the Illinois fish fauna, with the exception of one group, the Petalodontidæ, is duplicated in the Texas fauna, a condition that indicates a close relation between the faunas of these two remote regions. A comparison of the Texas fauna with that of Bohemia shows a marked difference in the genera of the two localities, although, with one exception, the groups represented in each are the same. From this the author draws the conclusion that although the faunas must have arisen from a common stock, the two regions had long been separated before Permian times.

Through oversight, most likely, a few mistakes, of minor importance, perhaps, have been made to which attention should be called. The statement is made that *Ophiacodon mirus* Marsh and *O. grandis* Marsh, which Marsh considered reptiles, "are clearly amphibians of uncertain relationships." Williston has recently shown that *O. mirus* is a reptile and that *O. grandis* belongs with *Eryops*.

Pleuristion, which is evidently considered an amphibian and is placed under the Gymnarthria without comment, was treated by Dr. Case in his "Revision of the Pelycosauria" (p. 27). Here he is in doubt as to whether

the genus is more closely allied to the Pelycosaurs or the Cotylosaurs. From evidence furnished by the humerus, as described and figured by Williston, as well as the vertebræ, *Pleuristion* is, in all probability, a cotylosaur and probably a member of the Captorhinidæ.

In the description of the humerus of *Diplocaulus* (p. 90) Dr. Case expresses the opinion that it may be reptilian. To quote:

"This [*Diplocaulus*] is the single case among the *Amphibia* of the Texas Red Beds, or their equivalent elsewhere, in which the entepicondylar foramen has been found in the humerus. The opening in the humerus of *Acheloma cummingsi* is purely accidental in the opinion of Williston, Broom and the author. For this reason it is possible that the humerus may be reptilian and in accidental association."

This hardly seems possible as these humeri are found associated with many specimens of *Diplocaulus* in the University of Chicago collection. And, furthermore, according to Broili, *Cochleosaurus*, an Upper Carboniferous Temnospondyl, has the entepicondylar foramen present in the humerus.

The present work will be of great interest to all paleontologists and of inestimable value to the student of Permian vertebrates. The compilation is so complete that it will no longer be necessary to turn to the original papers on these groups for the information desired. The text is illustrated with a great many new figures as well as copies after Broili, Williston and others. The plates, too, are worthy of special mention.

MAURICE G. MEHL

NOTES ON INFECTIOUS ABORTION IN CATTLE

IN recent numbers of SCIENCE Dr. Russell¹ and Dr. MacNeil have called attention to the fact that infectious abortion of cattle in this country is undoubtedly caused by the same organism as that found in Europe. It may

¹ Russell, H. L., SCIENCE, N. S., Vol. XXXIV., October 13, 1911, p. 494. MacNeil, W. J., SCIENCE, N. S., Vol. XXXIV., December 22, 1911, p. 874.

be of interest to very briefly review certain recent publications dealing with this disease. This is particularly true just at present, as it seems possible that this disease may have more than a passing interest for human medicine.

From the standpoint of the veterinarian the most important recent work is that from the laboratory of Dr. C. O. Jensen in Copenhagen, Denmark. This laboratory has devoted particular attention to the study of reliable methods of diagnosis. In September, 1909, Dr. Holth² published a preliminary report, on the use of agglutination and complement fixation for determining the presence of this disease.³ During the past year Sven Wall, working under the direction of Drs. Jensen and Holth, has published⁴ the account of extensive tests with these methods. Wall gives the details of the examination of eleven hundred (1,097) cows by the use of both methods. In many cases the cows were tested every month for from six to eight months. On the basis of this work Wall concludes that it is entirely possible by the combined use of these two methods to determine which cows are infected, or at least which ones have been infected within the last six or eight months. It should be noted here, however, that these serum tests offer no opportunity to distinguish between cows which have an active infection and those which have acquired a measure of immunity. Wall's work, however, indicates that the agglutinins and immune bodies gradually disappear. In from six months to a year after the

infection, it is usually not possible to demonstrate the presence of these bodies.

The work of Holth and Wall has been corroborated by a number of recent investigations dealing with this disease. Professor Zwick, of the Veterinary Division of the Royal Health Bureau in Berlin, has contributed several recent papers.⁵ He concludes that the methods of agglutination and complement fixation offer the proper means of diagnosis in this disease. Zwick also concludes that infectious abortion is much more widely spread among cattle than is usually believed. He further believes that infectious vaginitis is not a cause of abortion, but that the abortion in such cases is due to a separate infection with the Bang bacillus. Another paper dealing with the diagnosis of abortion is by Brüll⁶ from the veterinary school in Wien. Brüll, using the agglutination method alone, found that the serum of cows which had aborted agglutinated the abortion bacilli in dilutions from 1 to 64 up to 1 to 16,000. The cows which had not aborted and came from farms where there had been no abortion never showed agglutination in dilutions higher than 1 to 64 and usually much lower. He concludes that this method may be used with success. All cows showing agglutination higher than 1 to 64 are believed to have been infected.

Still more recently MacFadyean and Stockman,⁷ of the English Abortion Committee, have thoroughly tested the agglutination method. Of 535 steers, bulls and calves, which *a priori* were assumed to be non-infected, only nine showed agglutination in the dilution of 1 to 50, four in the dilution of 1 to 100 and only one in the dilution of 1

² Holth, Halfdan, "Die Agglutination und die Komplementbindungsmethode in der Diagnosis des Seuchenhaften Verwerfens der Kühe," *Berl. Tierärztl. Woch.*, Bd. 25, pp. 686-688, 1909.

³ In the same year and independently, MacFadyean and Stockman, of the English Abortion Committee, also pointed out the possibility of using these methods.

⁴ Wall, Sven, "Om Diagnosticering af infectøse Kastning hos Kvaeg ved Agglutination og Komplementbinding," *Maanedsskrift f. Dyrlæger* XXI., 1910. Also "Ueber die Feststellung des seuchenhaften Abortus beim Rinde durch Agglutination und Komplementbindung," *Zeit. f. Infektionskr. usw. der Haustiere*, Bd. 10, 1911.

⁵ Zwick, *Central. f. Bakteriolog. usw.*, Bd. 47, I. Abt. Ref. (Beilage), 1910; *Berl. Tierärztl. Woch.*, Bd. 27, No. 6, pp. 111-112, February, 1911; *Berl. Tierärztl. Woch.*, Bd. 27, No. 52, pp. 965-969, December, 1911.

⁶ Brüll, Ziga, "Beitrag zur Diagnostik des infektiösen Abortus des Rindes," *Berl. Tierärztl. Woch.*, Bd. 27, pp. 721-727, 1911.

⁷ MacFadyean, Sir John, and Stockman, Stewart, "The Agglutination Test in the Diagnosis of Bovine Contagious Abortion," *Jour. Comp. Path. and Therap.*, Vol. XXV., pp. 22-38, March, 1912.

to 200. On the other hand, of 127 cows which had either aborted or came from infected herds, 62 (nearly 50 per cent.) gave some agglutination, although only 38 agglutinated in the dilution of 1 to 100 or more. Wall pointed out from his results that the use of the agglutination method alone is likely to lead to some errors and to many cases of uncertainty. In the main, however, as the above two papers indicate, its results are satisfactory.

Three papers dealing with the diagnosis of the disease in this country have recently appeared. The first of these is by Larson,⁸ in which he concludes that the complement fixation test offers a reliable and satisfactory method of diagnosis. Another paper which is a continuation of the work started by Larson is by Hadley and Beach,⁹ in which again the complement fixation reaction is used alone. A third paper is by the writer¹⁰ in which both the agglutination and complement fixation reactions were tested.

The results of these papers are in agreement with European investigations and indicate that a reliable method of diagnosis in this disease is now available.

The perfection of these methods of diagnosis undoubtedly marks the greatest step towards the eradication of this disease which has yet been made. By their use it is possible to separate the infected from the uninfected animals. By proper methods of isolation and disinfection much can then be done towards ridding a herd of the disease. This is especially true in herds where the infection has just started.

⁸ Larson, W. P., "The Complement Fixation Reaction in the Diagnosis of Contagious Abortion of Cattle," *Jour. Infect. Dis.*, Vol. 10, pp. 173-185, March, 1912.

⁹ Hadley, F. B., and Beach, B. A., "The Diagnosis of Contagious Abortion in Cattle by Means of the Complement Fixation Test," Wisconsin Agric. Exper. Station, Research Bulletin No. 24, June, 1912.

¹⁰ Surface, Frank M., "The Diagnosis of Infectious Abortion in Cattle," Ann. Rpt. Kentucky Agric. Exper. Station, 1912 (Bulletin 166), pp. 303-366, June, 1912.

In spite of the fact that the cause of this disease was discovered by Bang as early as 1896, very little progress has been made towards the perfection of a cure or a preventative. The most important contribution to this side of the subject also comes from Jensen's Laboratory and is by Dr. Halfdan Holth.¹¹ In an excellent contribution Holth gives many valuable observations on the growth and biology of the abortion bacilli. Many experiments dealing with the theory of immunity are also reported. The matter of most immediate interest, however, is that dealing with the artificial production of immunity. Holth clearly demonstrates that it is entirely possible to produce agglutinins and antibodies in animals treated with either living or dead cultures and with serum. Injection of living culture produces the largest amount of immune bodies and these remain in the blood for a longer period of time than with other treatments. Injection of a killed culture is the next most efficient way while the effects of an immune serum appear to be slight and transitory.

Experiments with rats and mice show that injection of either a serum or a properly prepared vaccine will protect them against an otherwise deadly dose of the abortion bacilli.

Whether these results will be borne out by experiments on cows or not is still unsettled. Experiments are under way in Denmark and other places which will settle this matter before long.

In this connection should be mentioned the excellent review by Oluf Bang¹² of the work

¹¹ Holth, Halfdan, "Kastningsbacillens Biologi og Immunitetsforholdene ved Sygdommen," *Maanedsskrift for Dyrlaeger*, XXII., 1911. Also "Untersuchungen über die Biologie des Abortusbacillus und die Immunitätsverhältnisse des infektiösen Abortus der Rinder," *Zeit. f. Infektionskrankheiten usw. der Haustiere*, Bd. X., 1911, 94 pp.

¹² Bang, Oluf, "Schutzimpfung gegen den infektiösen Abortus," Klimmer u. Wolff-Eisner's "Handbuch der Serumtherapie und Serumdiagnostik in der Veterinärmedizin," Leipzig, 1911, pp. 202-223.

that has been done in the attempt to protect animals against infectious abortion. Many experiments are reviewed in this article which are not to be found in the general literature of abortion. Many of these are scattered through Danish veterinary journals and many others are here published for the first time. The results of the experiments given indicate that there is some hope of producing immunity by means of vaccines or serums. There is, however, need of many long continued and carefully planned experiments to prove this. The insidious nature of the disease makes it very difficult to obtain crucial evidence. The above cited paper is an excellent summary of the work so far done in this direction.

Not the least interesting phase of the study of infectious abortion is that which has recently appeared from the laboratory of Dr. Theobald Smith.¹³ In these papers Smith and Fabyan have clearly demonstrated a fact which has been overlooked by previous students of this subject, viz., that the abortion bacillus is able to cause marked pathological lesions in guinea-pigs and other laboratory animals. Further, these lesions are by no means confined to the reproductive organs, but affect in particular, the spleen, liver, bones, lungs, lymph-nodes and kidneys. The lesions are not unlike those produced by tuberculosis. In a few cases death ensued after some weeks, in others the animals appeared to recover and maintain a general good health. No external symptoms, other than a slight loss in weight, were present in the majority of cases. In some instances paralysis of the hind quarters was noted. Occasional cases of blindness and the enlargement of the lymph nodes were other symptoms.

The interest in the disease is increased by the fact pointed out by Smith and later by the

¹³ Smith, Theobald, and Fabyan, Marshall, "Ueber die Pathogene Wirkung des Bacillus abortus Bang," *Central. f. Bakt. usw.*, I., Orig. Bd. 61, pp. 549-556, January, 1912. Fabyan, Marshall, "A Contribution to the Pathogenesis of *B. abortus* Bang," *Jour. Med. Research*, Vol. XXVI., pp. 441-489, July, 1912.

U. S. Department of Agriculture¹⁴ that the abortion bacillus occurs in the milk of infected cows and that the injection of such milk into healthy guinea-pigs will produce lesions similar to those noted above. Further, it is possible to recover the abortion bacilli from animals inoculated with such milk.

The fact that a large portion of dairy milk contains the abortion bacilli and the further fact that in cattle the most common means of infection is through the alimentary canal make it at least suggestive that this organism may be an etiological factor in certain human infections.

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SPECIAL ARTICLES

THE EFFECTS OF ALKALOIDS ON THE DEVELOPMENT OF FISH (*FUNDULUS*) EMBRYOS

In previous experiments it was found that a large number of neutral salts and many anesthetics, including alcohols, when applied to *Fundulus* embryos, in concentrations slightly below the fatal dose, produce abnormalities in the eyes. The most striking of these abnormalities is the presence of one median eye instead of the usual eyes, a condition known as cyclopia. In some embryos but one eye is present and is lateral, as in the normal fish, a defect designated as monophthalmia asymmetrica.

Considering the variety of the "poisons" used, one might suspect that the *Fundulus* embryo reacts to all poisons by developing defects in the eyes, provided the right concentration of the harmful substances is found. To determine this, it is not necessary to try an infinite number of concentrations of the reagent, since I found that the concentrations producing cyclopia were the highest concentrations in which the embryos could live. It is only necessary to determine the lethal dose, and then make a finely graduated series just below this limit. In this way I have tried out

¹⁴ Bureau of Animal Industry, U. S. Department of Agriculture, Circular No. 198, March, 1912.